

Section 524—Drilled Caisson Foundations

524.1 General Description

Drilled shafts (also called drilled piers or caissons) are constructed by excavating a cylindrical hole, placing reinforcing steel, and filling the hole with concrete.

Drilled shafts can be installed in larger diameters and can carry significantly higher loads than conventional piling. Because shafts are often used in place of numerous piling in foundations, the Contractor must construct them carefully.

524.1.01 Definitions

Dry Shaft: The bottom of the shaft has less than 3 in (75 mm) of water just before concreting.

Wet Shaft: The bottom of the shaft has over 3 in (75 mm) of water or is in slurry. Shafts with a relatively high influx of water (i.e., pumping is required to keep the water level below 3 in (75 mm)) are considered wet.

524.1.02 Related References

A. Standard Specifications

Section 500—Concrete Structures

B. Referenced Documents

General Provisions 101 through 150.

524.1.03 Submittals

General Provisions 101 through 150.

524.2 Materials

524.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

524.3 Construction Requirements

524.3.01 Personnel

General Provisions 101 through 150.

524.3.02 Equipment

General Provisions 101 through 150.

524.3.03 Preparation

A. Excavating Drilled Shafts

There are various methods for excavating drilled shafts. The choice of methods depends on the materials to be removed and whether the excavation is being made wet or dry.

The Contractor shall excavate the shaft to the depth shown in the Plans unless the expected material is not found at the Plan depth.

1. Wet Shaft Guidelines

The excavation time required for wet frictional shafts is critical because the sides of the excavation get soft over time.

If the Contractor does not concrete the shaft in the required period of time designated in the Plans or in Section 524 of the Specifications, the shaft must be reamed to remove the softened material.

2. Evaluating Materials Below the Shaft Tip

For shafts that develop most of their capacity from end bearing, the Engineer must evaluate the materials below the tip of the shaft. The Contractor shall drill a test hole approximately 6 ft (2 m) below the bottom of the shaft to facilitate this evaluation.

Section 524—Drilled Caisson Foundations

For end bearing shafts that have tips under water that cannot be visually inspected, the Contractor shall make cores to 10 ft (3 m) below the tip.

The [Geotechnical Engineering Bureau](#) should assist in this evaluation.

524.3.04 Fabrication

General Provisions 101 through 150.

524.3.05 Construction

A. Constructing Drilled Shafts

The method used to construct a drilled shaft depends on the following:

- The material through which the shaft is to be constructed
- Whether the excavation can be dewatered
- Whether the shaft is designed to develop load carrying capacity through end bearing or skin friction

The Engineer will monitor the construction of each shaft for two reasons:

- Most of the shaft is inaccessible for evaluation of integrity once it is cast.
- Replacing a defective shaft or repairing a foundation with a defective shaft is time consuming and costly.

1. Casing for Drilled Shafts

Casing is generally required through materials which might cave (although sometimes only slurry is required). The Contractor may install casing by drilling, pushing, or driving.

Vibratory hammers may be used to place or pull casing, but the Engineer will define their use and the conditions for their use.

The Special Provisions may prohibit certain installation or removal methods on a particular Project. If so, the Special Conditions of the Sequence of Operations Specification and/or the Drilled Shaft Special Provision will note any restrictions.

After the shaft is concreted, the Contractor shall remove any temporary casing using the following guidelines:

- a. Pull the casing with some tapping, if necessary.
- b. Remove temporary casing as soon as possible after pouring the concrete.
- c. Complete any casing removal work that causes vibrations or other disturbances within three hours after starting the concrete pour.

2. Placing Concrete

Before the Contractor places shaft concrete, the following must happen:

- The Contractor shall clean the bottom of the shaft of all soft materials.
- For slurry construction, the Contractor shall sample and test (in the Engineer's presence) the slurry at the bottom of the shaft to ensure that the requirements of Section 524 of the Specifications are met. If slurry tests outside of the specification limits, the Contractor shall correct it before placing concrete.

The Contractor shall follow these guidelines for pouring concrete:

- Follow the requirements for pulling the casing listed in Section 524 of the Specifications and any special conditions of the Sequence of Operations Specification.
To allow for loss after the casing is pulled, place an additional height of concrete.
- When pouring concrete underwater, use a measuring tape with a weight to monitor the top of the concrete.
If the concrete pour is underwater and is to be stopped below ground (i.e. the cutoff is below ground), pour extra concrete to adjust for possible contamination of the top of the concrete.

The method for placing concrete in the shaft depends on whether the bottom of the shaft is dry or wet.

a. Dry Shaft Concreting

The Contractor shall place concrete in a dry shaft according to Section 500 of the Specifications.

b. Wet Shaft Concreting

Section 524—Drilled Caisson Foundations

Concrete placed in a wet shaft may be either pumped or tremied. In either method, a plug, valve, or bottom plate is required to prevent water entering the line or to purge the line of water before placing concrete in the shaft.

Keep the tremie or pipe embedded in the concrete at least 5 ft (1.5 m) during the pour.

524.3.06 Quality Acceptance

A. Inspector's Responsibilities

1. Record Keeping

The Inspector is responsible for keeping records on the following items:

- a. The time at the beginning and the end of shaft excavation
- b. The time at the beginning and the end of concrete placement
- c. The diameter, length, and method of installing casing
- d. The method of excavation
- e. Any problems or obstructions encountered during excavation
- f. The depth of the water in the shaft before concreting
- g. The tip elevation of the shaft
- h. Any information on the condition and type of foundation material at the bottom of the shaft
- i. The volume of concrete placed in the shaft
- j. The slump of the concrete used
- k. The method of concrete placement
- l. The diameter and accepted top elevation of the shaft
- m. Any displacement of the reinforcement steel bar cage

2. Quality Assurance

The Inspector must examine or observe the measurement of the following items for compliance with the Plans and Special Provision 524—Drilled Caisson Foundations:

- a. The shaft location, depth, diameter, and alignment
- b. The bottom condition of the shaft immediately before concreting
- c. The consistency (viscosity, density, pH) of the slurry (natural or manufactured) at the bottom of the shaft
- d. The presence of appropriate spacers and the clearance between the reinforcement steel bar and the shaft sides
- e. The slump of the concrete before pouring
- f. The embedment of the tremie or concreting pipe during concreting

524.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

524.4 Measurement

General Provisions 101 through 150.

524.4.01 Limits

General Provisions 101 through 150.

524.5 Payment

General Provisions 101 through 150.

524.5.01 Adjustments

General Provisions 101 through 150.